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XXV.—*On the Classification of the Brachyura, and on the Homologies of the Antennary Joints in Decapod Crustacea.* By WM. STIMPSON, M.D.*

DR. STRAHL has recently been making some carcinological investigations †, which have led him to propose a new classification of the higher Crustacea. He considers the characters of the external antennæ, particularly of their second joint (basicerite) of paramount importance, and would divide the suborder Brachyura, in accordance with these characters, into four groups, namely,

Orbata, with the first two joints of the antenna only present, the rest wanting, as in *Acanthocyclus*.

Liberata, with the basicerite free, as in *Oncinopus*.

Incuneata, with the basicerite wedged between the pterygostomium and the epistome, as in *Cancer*.

Perfusa, with the basicerite completely united with the neighbouring parts, as in *Stenorhynchus*.

These differences are certainly of great importance, and have not generally received sufficient attention from carcinologists; but they can scarcely be used for the primary subdivisions, as they are not coincident with characters of still higher value. By their use we should be required to dismember well-marked groups—to separate, for instance, *Macrocheira* from the Maioids, and *Gecarcinus* from the Ocypodoids; while strange approximations would occur, as of *Oncinopus* with *Myctyris*. Experience has long since shown us that it is impossible to group animals upon the variations of a single organ.

Some of Dr. Strahl's conclusions are so surprising that they

* From Silliman's American Journal for January, 1863.

† Monatsbericht der Königl. Akademie der Wissenschaften zu Berlin, 1861; Ann. Nat. Hist. vol. ix. p. 299.

may well require the closest scrutiny before acceptance. For example, he says, "The *Leucosiæ* I consider to include only Dana's *Leucosidea*, with *Dorippe* and *Æthusa*. I separate the *Calappidæ* and *Matutidæ* from them, and unite them with the *Parthenopinæ* rejected from the *Oxyrhyncha*." This combination is justified "by the agreement in the situation of the afferent canal of the branchial cavity and of the male sexual organs," &c. But the *Calappidæ* are entirely removed from the *Parthenopinæ* in the structure of the mouth-parts; the buccal cavity is narrowed anteriorly so that the efferent branchial channels terminate at the middle instead of the sides of the endostome, and are covered by the indurated summits of the lacinia of the first pair of maxillipeds (tritocheirognathites). Like the *Leucosidea* they are oxystomatous, as Milne-Edwards has shown. They, indeed, differ from these latter in the situation of the efferent canals, and should therefore be separated as a distinct group; but they should no more be united to the *Parthenopinæ* than should the *Dorippidæ*, which Dr. Strahl would unite with the *Leucosidea*, although these are far more nearly allied to the *Calappidæ*, not having the afferent canal covered by the exognath of the outer maxillipeds, which is the case in all *Leucosidea*.

Again, Dr. Strahl remarks, "The genus *Grapsus*, limited by the rejection of *Leptograpsus*, *Metopograpsus*, &c., and represented by the species *Pharaonis*, *strigosus*, *Webbii*, &c., must be removed not only out of the *Grapsoidæ*, but even entirely out of the Brachyura, because the structure of the external antennæ differs completely from that which prevails amongst the Brachyura. *Grapsus*, for instance, has no operculum at the base of the external antennæ, but a perforated tubercle, as in the *Macrura*, and must therefore at least be placed among the *Anomura*." Here we would have *Leptograpsus variegatus* and *Grapsus strigosus*, for instance—forms so closely allied that they are placed in one and the same genus by so skilful a naturalist as Dana—separated so widely from each other that the latter species is placed among the *Anomura*! Let us examine fresh or wet specimens to ascertain whether *Grapsus* in reality has, at the base of the antennæ, a structure so essentially differing from that found in ordinary Brachyura. Dried specimens are too commonly used in these investigations, and are very apt to lead to error. The "operculum" spoken of above is the coxal joint (coxocerite) of the external antennæ, which is moveable in all crabs, even where the next (basicerite) is not. In a *Maia*, for example, this coxal joint may be raised a little, so that the membranous areola* which occupies its postero-interior surface may

* The so-called *tympanum*. It is very doubtful whether the auditory organ is ever here situated. Kröyer has demonstrated (Kongl. Danske

be partially seen. In *Leptograpsus* this areola is more exposed, encroaching somewhat upon the margin or outer surface of the coxal joint, or, in other words, this joint is kept permanently a little raised. In *Grapsus* the coxal joint (here the "perforated tubercle" of Strahl) is still more evolved, and its sides are folded in, giving it a globular form, and contracting the areola, which is thus placed in a slit, and becomes almost wholly external. The different form of the coxocerite in *Grapsus* is therefore the result of a simple modification, not of structural importance. In *Dromia* the coxal joint is also slit at one side, but the areola is on the inner surface. This joint in *Dromia* is not "so shrunken that only the tubercle remains." It is far larger in proportion than is usual in the higher Crustacea. Dr. Strahl says that "if we imagine the slit in the tubercle of *Dromia* carried out to one side, so that here the peripheral margin is completely separated, we have the operculum of the *Brachyura* in its perfect form." But this prolongation of the slit would cut the coxal joint in two, which is not the case in the "operculum;" for this "operculum" is truly the homologue of the coxocerite of *Dromia* and *Homarus* in its entirety, as may be seen by comparison with this part in *Pilumnus*, for instance, where the basicerite is not soldered to the contiguous parts as is usual in Cancroids, but is free and articulated directly with the "operculum" in the same manner as it is with the coxal joint in the other two genera named. *Pilumnus*, we may remark incidentally, would be classed with *Parthenope* by the character of its antennæ.

Dr. Strahl proposes new names for the first two joints of the external antennæ: the first (coxocerite) he would call *intercalare*; the second (basicerite) *armiger*, while the third (ischiocerite) he calls the first joint of the antennæ, which is certainly liable to mislead. Prof. Milne-Edwards, who has done so much towards elucidating the homologies of these joints, has given to them the names in brackets, which are more appropriate; for there is undoubtedly a perfect correspondence between them and the joints of the maxillæ or feet. I believe it possible to carry the homology even further than the celebrated French zoologist has done, and that the antenna in question, like a foot or maxilliped, consists normally of seven joints. In the embryo of *Hippolyte*, as figured by Krøyer*, there are five distinct joints beyond the basicerite, which would make seven in all. Moreover, they can be demonstrated in the adult *Squilla*, *Axius*, and *Pagurus*, and

Vidensk. Selskabs Skrifter, 1856, iv. 288) that a far more complicated auditory apparatus exists at the base of the internal antennæ.

* Monog. Fremst. af Hippolyte's Nordiske Arter, &c. tab. vi. f. 121.

particularly well in *Homarus*, where the parts are more distinct from their large size. The "peduncle" of the antenna in the Lobster is considered by Milne-Edwards to consist of five joints; but a sixth is indicated at the base of the penult, on the lower side of the member. Here there is a small triangular piece, articulating with the second and third joints as well as the penult, perfectly mobile, and dependent upon no one of these joints more than another. An additional evidence that this piece is the representative of a distinct joint is furnished by the fact that the articulations of the two proximate joints are in the same plane, and not, as should be the case were they normally contiguous, in planes perpendicular to each other. To complete the number (seven) of joints, we have the flagellum, which corresponds to the dactylos or terminal joint of the thoracic members. This homology is rendered probable by the occurrence, in the remarkable Hippidean genus *Mastigopus**, discovered by me in the Chinese seas, of a multiarticulate dactylus to the chelipeds perfectly similar to the flagelliform terminal appendage of an antenna.

The squamiform appendix of the antenna is attached to the second joint, and is homologous to the exopod of the feet, or the exognath of the maxillipeds, which has the same position. It is called *scaphocerite* by Milne-Edwards, but would be more appropriately named *exocerite*, a term indicating its relations with greater exactness, and corresponding in construction with that of its homologues. This appendage is normally two-jointed, as is seen in the embryo *Homarus* and in the adult *Squilla*; its basal joint is obsolete or coalesced with the terminal squamiform joint in adult *Macrura* and *Anomura*, while in *Brachyura* the entire appendage disappears with perfect development. The little basal joint of the exocerite in the embryo *Homarus* is mistaken for the "armiger" (basicerite) by Dr. Strahl, who considers the large joint which supports both branches of the antenna as the "intercalare" (coxocerite), on the ground that in the adult the third joint is articulated with both the coxocerite and the basicerite. But this is so only in appearance: if the antenna in a fresh Lobster or Cray-fish be bent outward, it will be seen that the posterior condyle of the third joint articulates with the basicerite alone. The basicerite, in the embryo Decapod, is far from being the trifling joint seen at the base of the scale-like appendage, but is, in fact, that large supporting joint which is the first to make its appearance, and which often reaches, with its exocerite, a large size before any trace of other joints, either coxal or terminal, can be perceived. In the figures accompanying the

* Proc. Acad. Nat. Sc. Philad. December 1858. Not the *Mastigopus* of Leuckart, which is a *Sergestes*.

valuable observations of Mr. C. Spence Bate*, this character of the basicerite is well shown in representations of the Zœa of *Carcinus mœnas*. Here we have the joint in question very large, armed with a long spine on one side and the exocerite on the other, while the rest of the antenna is in a rudimentary condition, and there is no coxocerite visible. This latter joint, with its areola, makes its appearance at a later date, at the base of the basicerite.

The large comparative size of the exocerite in the embryo is in accordance with what we observe in the gradations of adult Crustacea. Those lowest in the series have generally the external branch of their members most developed; as we rise in the scale, we observe the inner branch becoming more and more developed, while the outer branch is reduced, and may disappear entirely. Compare, for example, the thoracic feet of some Schizopods with those of the Caridea and Brachyura.

XXVI.—*Notes on rare and little-known Fishes taken at Madeira.*

By JAMES YATE JOHNSON, Cor. Mem. Z. S.

No. III.

Fam. Pleuronectidæ.

Solea oculata, Risso.

D. 68. A. 51. P. 7. V. 4. C. 15.

Left side white; right side a pale brown, marbled with deeper brown. On the anterior part of the body are five large patches of very dark brown. The tail is also of this colour, and the patch is divided from the paler colour of the body by a series of six yellow spots. The most noticeable markings on the right side of the body consist of four round or oval dark-brown, almost black spots, each surrounded by a ring of small bright yellow spots. These are arranged in two pairs, the members of each pair being placed over against each other at the base of the dorsal and anal fins respectively. A line drawn from one spot of the first pair to the other would divide the fish into two nearly equal portions. All the fins are edged with white. At the base of the caudal fin there is a narrow band of pale brown; the rest of the fin is a darker brown. The irides of the eyes are bright greenish-blue, surrounded by a ring of gold.

The length of the head, compared with the total length, is as 1 to $5\frac{1}{3}$; the height, to the total length, is as 1 to 3.

There are numerous soft papillæ in the neighbourhood of the

* Phil. Trans. 1858, pl. xl. f. B 3, &c.